Sample Scoring Materials for Parts A, B, and C

Scoring Key for Multiple-Choice Questions in Parts A and B-1

Part A

(1)	1	(10)	1	(19)	2	(28)	2
(2)	4	(11)	3	(20)	1	(29)	2
(3)	1	(12)	1	(21)	2	(30)	1
(4)	2	(13)	3	(22)	4	(31)	2
(5)	4	(14)	1	(23)	2	(32)	2
(6)	2	(15)	4	(24)	3	(33)	2
(7)	3	(16)	4	(25)	1	(34)	2
(8)	2	(17)	1	(26)	1	(35)	3
(9)	1	(18)	2	(27)	4		

Part B-1

(36)	1	(41)	1	(46)	4
(37)	4	(42)	4	(47)	2
(38)	1	(43)	4	(48)	2
(39)	4	(44)	1		
(40)	3	(45)	1		

Scoring Criteria for Calculations

For each question requiring the student to *show all calculations, including the equation and substitution with units,* apply the following scoring criteria:

- Allow one credit for the equation and substitution of values with units. If the equation and/or substitution with units is not shown, do not allow this credit.
- Allow one credit for the correct answer (number and unit). If the number is given without the unit, do not allow this credit.
- Penalize a student only once per equation for omitting units.
- Allow full credit even if the answer is not expressed with the correct number of significant figures.

Scoring Guide for Parts B-2 and C

Part B-2

49 Allow 1 credit for 20. N or 20 N.

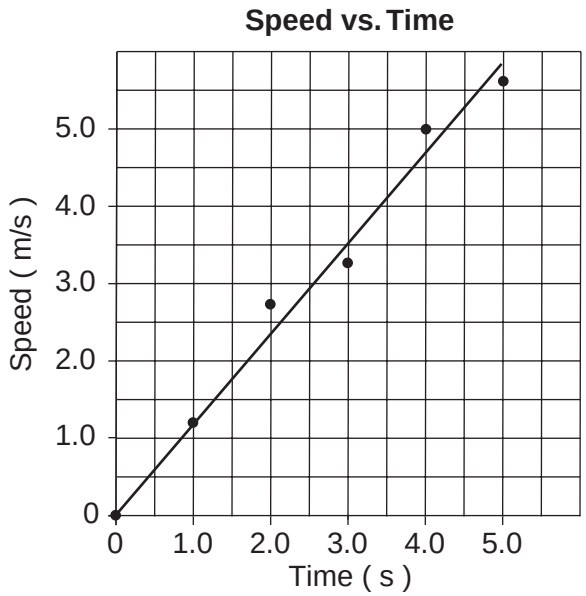
Rating Instructions for Questions 50, 51, and 52:

50 Allow 1 credit for plotting the data correctly.

51 Allow 1 credit for drawing a line of best fit.

52 Allow 1 credit for correctly sketching a line representing an object decelerating uniformly in a straight line (accept any straight line with a negative slope).

Example of an appropriate graph:



53 Allow 1 credit for indicating that the acceleration of the object is 1.2 m/s^2 or an answer that is consistent with the student's graph.

54 Allow 1 credit for *R*, *U*, *Y*.

55 Allow 1 credit for *W*, *X*, *Z*.

56 Allow 1 credit for 6V .

57 Allow 1 credit for 1.2 cm ±0.2 cm.

58 Allow 1 credit for 4.6 cm ±0.2 cm.

59 Allow 1 credit for indicating that the wavelength would decrease.

60 Allow 1 credit for 4.

61 Allow a total of 2 credits. Refer to Scoring *Criteria for Calculations* in this scoring key.

Example of Acceptable Response

$$E = \frac{hc}{\lambda}$$

$$E = \frac{6.63 \times 10^{-34}\text{J•s}(3.00 \times 10^{8}\text{m/s})}{6.58 \times 10^{-17}\text{m}}$$

$$E = 3.02 \times 10^{-19}\text{J}$$

62 Allow 1 credit for 1.89 eV or an answer consistent with the student's response to question 61.

63 Allow 1 credit for 3 and 2 or an answer consistent with the student's response to question 62.

64 Allow 1 credit for indicating that it cannot be an x-ray because the wavelength is too long.

Part C

65 Allow a total of 3 credits, 1 for each correct charge as indicated in the chart below.

Sphere	Charge
R	neutral
T	positive
U	positive

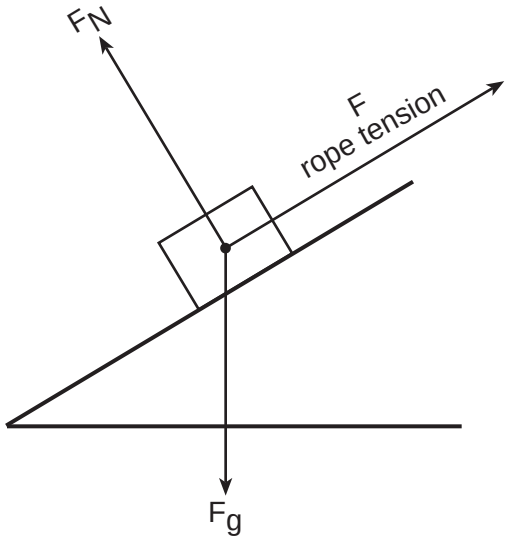
66 Allow a total of 3 credits**.**

Allow 1 credit for each vector correctly drawn with an arrowhead at the end and appropriately labeled.
Allow 2 credits for all three vectors correctly drawn but missing one or more labels.

Subtract 1 credit for one or more additional vectors that are not of the correct three (but do not give the student a score of less than zero).

Do not penalize the student if vectors are not drawn to scale.

Example of Acceptable Response



67 Allow a total of 2 credits, 1 credit for indicating kinetic energy when the block is in position *A* and 1 credit for indicating potential energy when the block is in position *B*. Appropriate responses include, but are not limited to:

Position *A:* kinetic or KE, or energy of motion
Position *B:* elastic or potential, or energy of position

68 Allow a total of 2 credits, 1 credit for $mg\Delta h = \frac{1}{2} kx^2$ or $\Delta PE = PE_S$ and 1 credit for solving *k*.

Example of Acceptable Response

$\Delta PE = mg\Delta h$

$PE_S = \frac{1}{2} kx^2$

$\frac{1}{2} kx^2 = mg\Delta h$

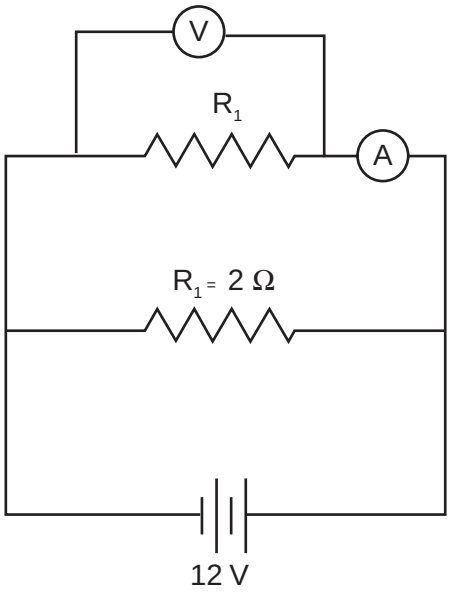
$k = \frac{2mg\Delta h}{x^2}$

Do *not* allow this credit if the student only lists formulas from the reference tables without indicating their equality.

69 Allow a total of 3 credits, allocated as follows:

- 1 credit for R_1 and R_2 connected in parallel with the battery
- 1 credit for the ammeter connected in series with R_1, only
- 1 credit for the voltmeter connected in parallel with R_1 or equivalent position

Example of Acceptable Response



70 Allow 1 credit for 2.0 V or 2 V .

71 Allow a total of 2 credits. Refer to *Scoring Criteria for Calculations* in this scoring key.

Example of Acceptable Responses

$$\frac{1}{R_1}+\frac{1}{R_2}=\frac{1}{R_{eq}}$$

$$\frac{1}{R_1}=\frac{1}{R_{eq}}-\frac{1}{R_2}$$

$$\frac{1}{R_1}=\frac{1}{2.0\Omega}-\frac{1}{3.0\Omega}$$

$$\frac{1}{R_1}=\frac{1}{6.0\Omega}$$

$$R_1=6\Omega$$

or

$$I_2=\frac{V_2}{R_2}=\frac{12V}{3.0\Omega}=4.0\text{A}$$

$$I_1=6.0A-4.0A=2.0\text{A}$$

$$R_1=\frac{V_1}{I_1}=\frac{12V}{2.0A}=6\Omega$$

72 Allow 1 credit for 10^{-8}.

73 Allow 1 credit for 10^{-47}.

74 Allow a total of 2 credits for explaining why gravitational interaction is negligible for the hydrogen atom by using responses to questions 72 and 73.

Appropriate responses include, but are not limited to:

- The electrostatic force is 10^{39} stronger than the gravitational force.
- The gravitational force is smaller than the electromagnetic interaction.

Allow credit for an answer that is consistent with the student's answers to questions 72 and 73.

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2002 Edition Reference Tables for Physical Setting/Physics

List of Physical Constants

Name	Symbol	Value
Universal gravitational constant	G	6.67×10^{-11} N•m^2/kg^2
Acceleration due to gravity	g	9.81 m/s^2
Speed of light in a vacuum	c	3.00×10^8 m/s
Speed of sound in air at STP		3.31×10^2 m/s
Mass of Earth		5.98×10^{24} kg
Mass of the Moon		7.35×10^{22} kg
Mean radius of Earth		6.37×10^6 m
Mean radius of the Moon		1.74×10^6 m
Mean distance—Earth to the Moon		3.84×10^8 m
Mean distance—Earth to the Sun		1.50×10^{11} m
Electrostatic constant	k	8.99×10^9 N•m^2/C^2
1 elementary charge	e	1.60×10^{-19} C
1 coulomb (C)		6.25×10^{18} elementary charges
1 electronvolt (eV)		1.60×10^{-19} J
Planck's constant	h	6.63×10^{-34} J•s
1 universal mass unit (u)		9.31×10^2 MeV
Rest mass of the electron	m_e	9.11×10^{-31} kg
Rest mass of the proton	m_p	1.67×10^{-27} kg
Rest mass of the neutron	m_n	1.67×10^{-27} kg

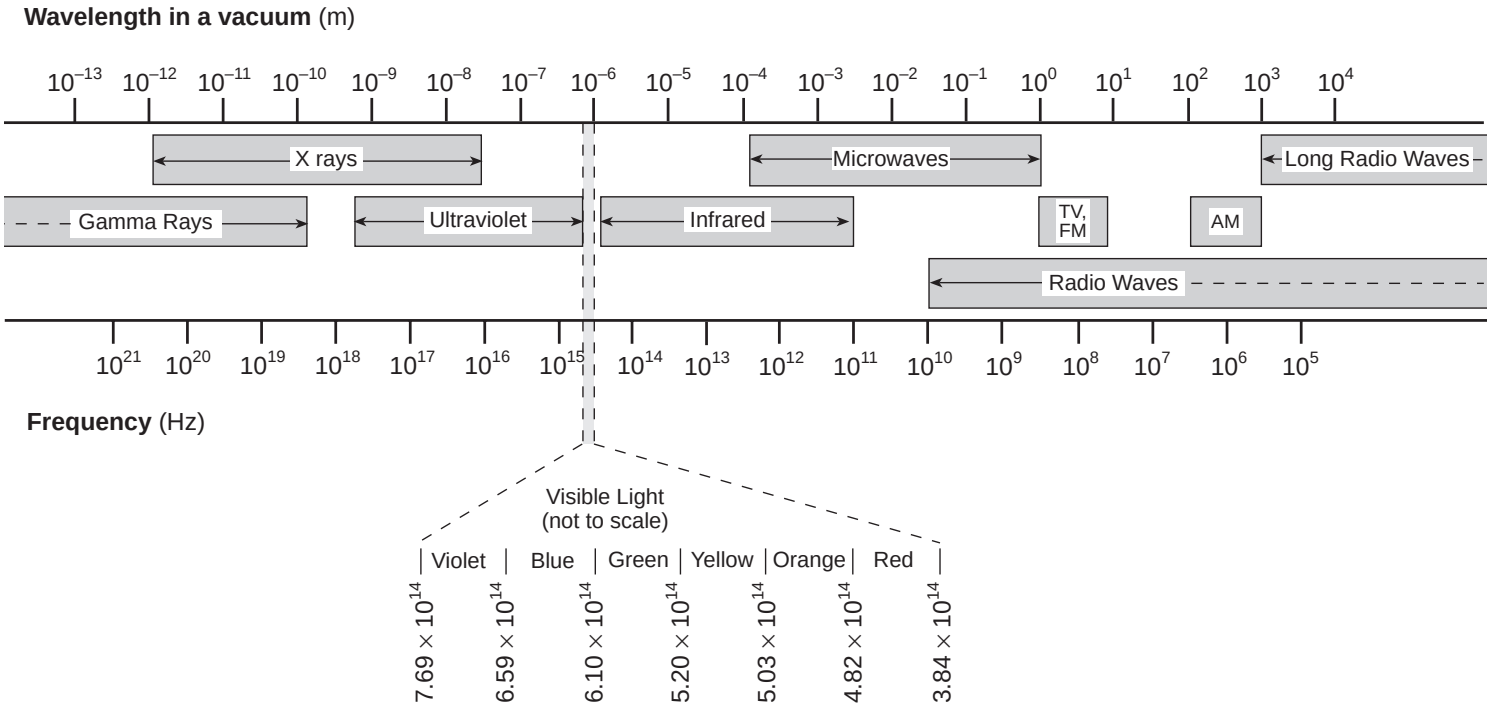
Prefixes for Powers of 10

Prefix	Symbol	Notation
tera	T	10^{12}
giga	G	10^9
mega	M	10^6
kilo	k	10^3
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}

Approximate Coefficients of Friction

	Kinetic	Static
Rubber on concrete (dry)	0.68	0.90
Rubber on concrete (wet)	0.58	
Rubber on asphalt (dry)	0.67	0.85
Rubber on asphalt (wet)	0.53	
Rubber on ice	0.15	
Waxed ski on snow	0.05	0.14
Wood on wood	0.30	0.42
Steel on steel	0.57	0.74
Copper on steel	0.36	0.53
Teflon on Teflon	0.04	

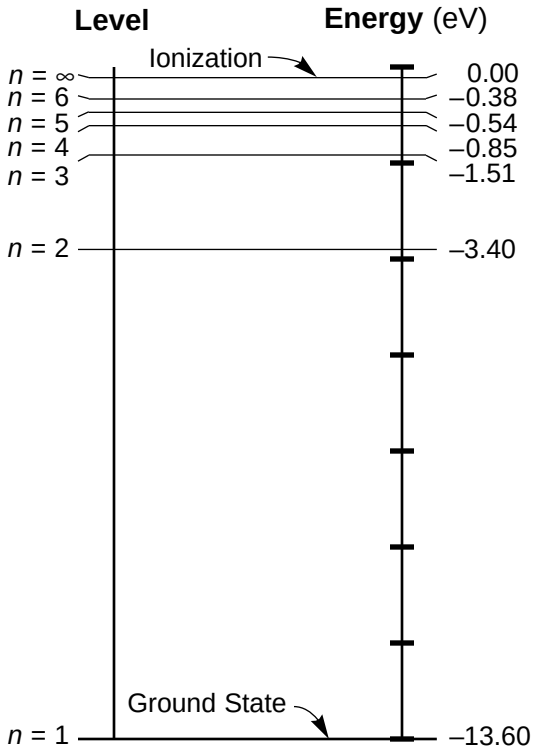
The Electromagnetic Spectrum



Absolute Indices of Refraction ($f = 5.09 \times 10^{14}$ Hz)	
Air	1.00
Corn oil	1.47
Diamond	2.42
Ethyl alcohol	1.36
Glass, crown	1.52
Glass, flint	1.66
Glycerol	1.47
Lucite	1.50
Quartz, fused	1.46
Sodium chloride	1.54
Water	1.33
Zircon	1.92

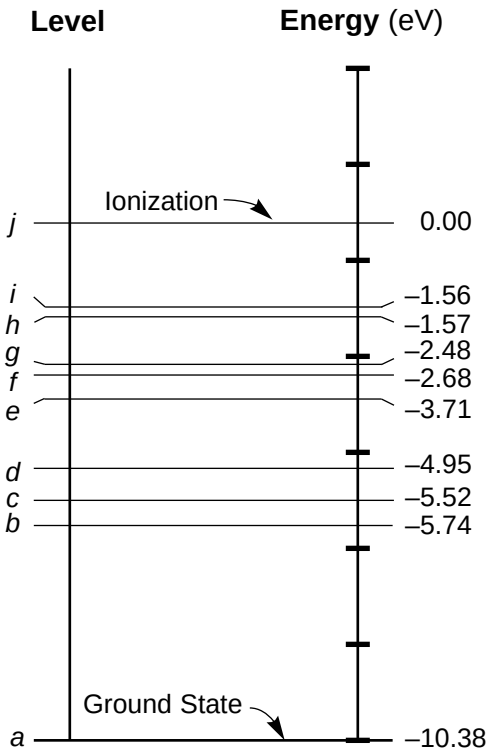
Energy Level Diagrams

Hydrogen



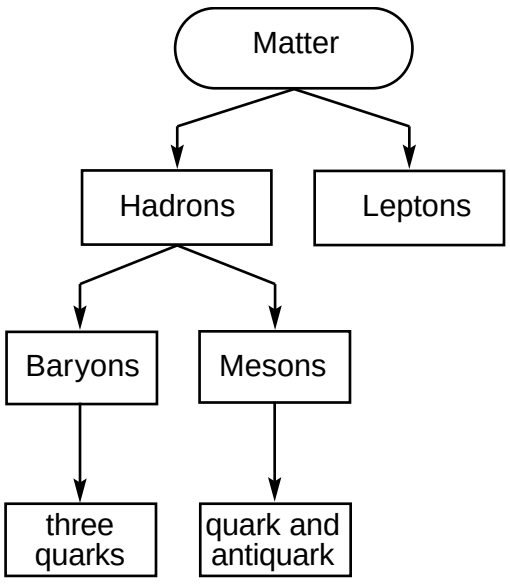
Energy Levels for the Hydrogen Atom

Mercury



A Few Energy Levels for the Mercury Atom

Classification of Matter



Particles of the Standard Model

Quarks

Name	up	charm	top
Symbol	u	c	t
Charge	$+\frac{2}{3}$ e	$+\frac{2}{3}$ e	$+\frac{2}{3}$ e
	down	strange	bottom
	d	s	b
	$-\frac{1}{3}$ e	$-\frac{1}{3}$ e	$-\frac{1}{3}$ e

Leptons

electron	muon	tau
e	μ	τ
–1e	–1e	–1e
electron neutrino	muon neutrino	tau neutrino
ν_e	ν_μ	ν_τ
0	0	0

Note: For each particle there is a corresponding antiparticle with a charge opposite that of its associated particle.

Electricity

$$F_e = \frac{kq_1q_2}{r^2}$$

$$E = \frac{F_e}{q}$$

$$V = \frac{W}{q}$$

$$I = \frac{\Delta q}{t}$$

$$R = \frac{V}{I}$$

$$R = \frac{\rho L}{A}$$

$$P = VI = I^2R = \frac{V^2}{R}$$

$$W = Pt = VIt = I^2Rt = \frac{V^2t}{R}$$

A = cross-sectional area
E = electric field strength
F_e = electrostatic force
I = current
k = electrostatic constant
L = length of conductor
P = electrical power
q = charge
R = resistance
R_{eq} = equivalent resistance
r = distance between centers
t = time
V = potential difference
W = work (electrical energy)
Δ = change
ρ = resistivity

Series Circuits

$$I = I_1 = I_2 = I_3 = \ldots$$

$$V = V_1 + V_2 + V_3 + \ldots$$

$$R_{eq} = R_1 + R_2 + R_3 + \ldots$$

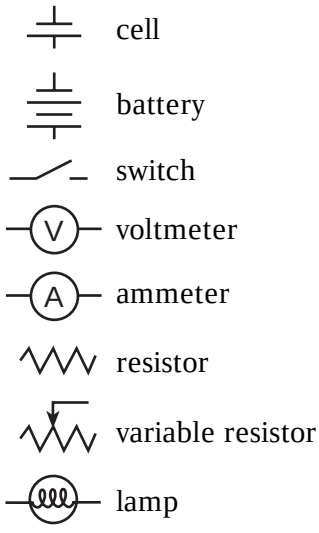
Parallel Circuits

$$I = I_1 + I_2 + I_3 + \ldots$$

$$V = V_1 = V_2 = V_3 = \ldots$$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$$

Circuit Symbols



cell
battery
switch
voltmeter
ammeter
resistor
variable resistor
lamp

Resistivities at 20°C

Material	Resistivity (Ω•m)
Aluminum	2.82×10^{-8}
Copper	1.72×10^{-8}
Gold	2.44×10^{-8}
Nichrome	$150. \times 10^{-8}$
Silver	1.59×10^{-8}
Tungsten	5.60×10^{-8}

Waves and Optics

$v = f\lambda$

$T = \frac{1}{f}$

$\theta_i = \theta_r$

$n = \frac{c}{v}$

$n_1 \sin\theta_1 = n_2 \sin\theta_2$

$\frac{n_2}{n_1} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2}$

c = speed of light in a vacuum
f = frequency
n = absolute index of refraction
T = period
v = velocity
λ = wavelength
θ = angle
θ_i = incident angle
θ_r = reflected angle

Modern Physics

$E_{photon} = hf = \frac{hc}{\lambda}$

$E_{photon} = E_i - E_f$

$E = mc^2$

c = speed of light in a vacuum
E = energy
f = frequency
h = Planck's constant
m = mass
λ = wavelength

Geometry and Trigonometry

Rectangle

$A = bh$

Triangle

$A = \frac{1}{2}bh$

Circle

$A = \pi r^2$
$C = 2\pi r$

Right Triangle

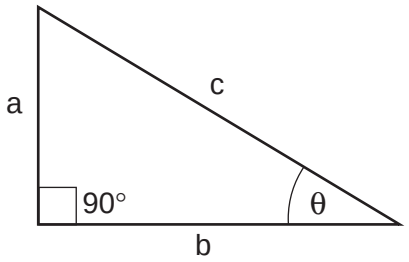
$c^2 = a^2 + b^2$

$\sin\theta = \frac{a}{c}$

$\cos\theta = \frac{b}{c}$

$\tan\theta = \frac{a}{b}$

A = area
b = base
C = circumference
h = height
r = radius



Mechanics

$$\bar{v} = \frac{d}{t}$$

$$a = \frac{\Delta v}{t}$$

$$v_f = v_i + at$$

$$d = v_i t + \frac{1}{2}at^2$$

$$v_f^2 = v_i^2 + 2ad$$

$$A_y = A \sin \theta$$

$$A_x = A \cos \theta$$

$$a = \frac{F_{net}}{m}$$

$$F_f = \mu F_N$$

$$F_g = \frac{Gm_1m_2}{r^2}$$

$$g = \frac{F_g}{m}$$

$$p = mv$$

$$p_{before} = p_{after}$$

$$J = Ft = \Delta p$$

$$F_s = kx$$

$$PE_s = \frac{1}{2}kx^2$$

$$F_c = ma_c$$

$$a_c = \frac{v^2}{r}$$

$$\Delta PE = mg\Delta h$$

$$KE = \frac{1}{2}mv^2$$

$$W = Fd = \Delta E_T$$

$$E_T = PE + KE + Q$$

$$P = \frac{W}{t} = \frac{Fd}{t} = F\bar{v}$$

a = acceleration

a_c = centripetal acceleration

A = any vector quantity

d = displacement/distance

E_T = total energy

F = force

F_c = centripetal force

F_f = force of friction

F_g = weight/force due to gravity

F_N = normal force

F_{net} = net force

F_s = force on a spring

g = acceleration due to gravity or gravitational field strength

G = universal gravitational constant

h = height

J = impulse

k = spring constant

KE = kinetic energy

m = mass

p = momentum

P = power

PE = potential energy

PE_s = potential energy stored in a spring

Q = internal energy

r = radius/distance between centers

t = time interval

v = velocity/speed

$\bar{v}$ = average velocity/average speed

W = work

x = change in spring length from the equilibrium position

Δ = change

θ = angle

μ = coefficient of friction

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Appendix I

Examination Blueprint

Content Standard 4	
Performance Indicator	Approximate Weight (%)
4.1	30-40
4.3	15-25
5.1	35-45
5.3	5-15

Process Skills	Percentage of Examination
Standard 1	75-85
Standard 2	0-5
Standard 6	5-15
Standard 7	0-5

Approximately 35-55% of the questions will be related to Key Idea 4 and 5 process skills.

Appendix II

Mapping the Core Curriculum to the Sampler			
Question Number	Content Standard 4	Process Skills Standard 4	Process Skills Standards 1,2,6,7
1	5.1a		
2	5.1d		St 1:M1.1
3	5.1d		St 1:M1.1
4	5.1e		
5	5.1f		
6	5.1j		
7	5.1k		St 1:M1.1
8	5.1l		St 6:5.1
9	5.1n		
10	5.1n		
11	5.1r		St 1:M1.1
12	5.1k		St 1:M1.1
13	5.1q		
14	5.1u		St 6:5.1
15	5.1s		St 1:M Key Idea 1
16	5.1u		St 6:5.1
17	4.1g		St 1:M1.1
18	4.1g		St 1:M1.1, St 1:S3.1
19	4.1i		St 1:M1.1
20	4.1j		St 1:M1.1
21	4.1p		St 1:M1.1
22	4.1p		St 1:M Key Idea1
23	5.3f		
24	4.1n		
25	4.3c		St 1:S3.1, St 1:M1.1
26	4.3c		St 1:S3.1
27	4.3k		St 1:M1.1
28	4.3l	4.3*vii*	St 1:S3.1
29	4.3m		
30	4.1i	4.3*viii*	St 1:S3.1
31	5.3b		
32	5.3b		St 6:2.4
33	5.3j		St 1:S 3.2, St 6:3.2
34	4.1a		St 1:S 3.1, St 6:5.1

35	5.3e		St 1:S 3.1, St 6:5.1
36	5.1a		St 6:3.2
37	5.1c	5.1iv	St 1:M1.1
38	5.1b	5.1vi	
39	5.1m		St 1:M3.1, ST 1:M2.1
40	5.3g		St 1:M1.1
41	5.1s	4.1xv	St 1:S3.1
42	4.1d		St 1:M2.1
43	4.1e	4.1i	St 1:S3.1
44	4.1m		St 6:5.1
45	4.3e		St 1:S1
46	4.3i	4.3ix	St 1:S3.1, St 1:M1.1
47	4.3m	4.3vi	St 1:S3.1
48	4.3h	4.3vii	Intro., St 1:M1.1
49	5.1o	5.1viii	St 1:S3.1, St 1:M1.1
50	5.1d	5.1i	St 1:M1.1, St 1:S3.1
51	5.1d	5.1i	St 1:M1.1, St 1:S3.2
52	5.1d	5.1i	
53	5.1d	5.1ii	St 1:M2.1, St 6:5.1
54		4.1iv	St 1:S2.1, St 6:1.1
55		4.1iv	St 1:S2.1, St 6:1.1
56	4.1l	4.1xiii	St 1:S3.1, St 1:M1.1
57	3c Intro.,		St1:S3.1
58	4.3c Intro.,		St1:S3.1
59	4.3m	4.3i	
60	4.3m	4.3iii	St 1:S3.1
61	5.3d		St 1:M3.1
62	5.3d		Intro.
63	5.3d	5.3i	
64	4.3g	4.3i, reference table	
65	5.1t		St 1:S2
66	5.1j	5.1viiii	St 6: Key Idea 4
67	4.1a,	4.1c, 4.1d, 4,1e	4.1v, 4.1i St 1:S3.1
68	4.1a, 4.1c, 4.1d,	4.1i, 4.1ii, 4.1iii 4,1e, 5.1m	St 1:M1.1
69	4.1o, 4.1n	4.1iii St 1:S3.1	
70	4.1o, 4.1l		St 1:M1.1
71	4.1o, 4.1l		St 1:M1.1
72	5.3h, 5.1u		St 2:1.3, St 6:3.2
73	5.3h, 5.1u		St 2:1.3, St 6:3.2
74	5.3h, 5.1u		St 2:1.3, St 6:3.2

Appendix III

Mapping the Sampler to the Core Curriculum Content Standards			
Content Standards	Test Sampler Question Numbers		
	Part A	Part B	Part C
4.1a	34		67, 68
4.1b			
4.1c			(67, 68)
4.1d		42	(67, 68)
4.1e		43	(67, 68)
4.1f			
4.1g	17, 18		
4.1h			
4.1i	19, 30		
4.1j	20		
4.1k			
4.1l		56	(70, 71)
4.1m		44	
4.1n	24		(69)
4.1o			69, 70, 71
4.1p	21, 22		
4.3a			
4.3b			
4.3c	25, 26	57, 58	
4.3d			
4.3e		45	
4.3f			
4.3g		64	
4.3h		48	
4.3i		46	
4.3j			
4.3k	27		
4.3l	28		
4.3m	29	59, 60	

4.3n		47	
5.1a	1	36	
5.1b		38	
5.1c		37	
5.1d	2, 3	50, 51, 52, 53	
5.1e	4		
5.1f	5		
5.1g		40	
5.1h			
5.1i			
5.1j	6		66
5.1k	7, 12		
5.1l	8		
5.1m		39	
5.1n	9, 10		
5.1o		49	
5.1p			
5.1q	13		
5.1r	11		
5.1s	15	41	
5.1t			65
5.1u	14,16		(72, 73, 74)
5.3a			
5.3b	31, 32		
5.3c			
5.3d		61, 62, 63	
5.3e	35		
5.3f	23		
5.3g			
5.3h			72, 73, 74
5.3i			
5.3j	33		

Appendix IV

Mapping Sampler to the Core Curriculum Process Skills			
Process Skills	Test Sampler Question Numbers		
	Part A	Part B	Part C
Standard 4			
4.1i		43	68, (67)
4.1ii			(68)
4.1iii			69 (68)
4.1iv		54, 55	
4.1v			67
4.1vi		47	
4.1vii	28	48	
4.1viii	30		
4.1ix		46	
4.1x			
4.1xi			
4.1xii			
4.1xiii		56	
4.1xiv			
4.1xv		41	
4.3i		59, 64	
4.3ii			
4.3iii		60	
4.3iv			
4.3v			
4.3vi			
4.3vii			
4.3viii			
4.3ix			
5.1i		50, 51, 52	
5.1ii		53	

5.1iii			
5.1iv		37	
5.1v			
5.1vi		38	
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New York State Education Department, Room 674 EBA, Albany, NY 12234

Physical Setting/Physics Regents Examination Test Sampler Draft Fall 2001 Comment Sheet

Please circle "Yes" or "No" and share your comments for each question below.

1. **Content**—Are the questions generally appropriate in content? YES NO
   Comments:

2. **Difficulty**—Are the questions generally appropriate in difficulty? YES NO
   Comments:

3. **Directions**—Are the directions clear and easy for students to follow? YES NO
   Comments:

4. **Scoring Materials**—Are the scoring materials for Parts B and C clear and easy for teachers to follow? YES NO
   Comments:

5. **Time**—Would most of the students be able to complete this test within the time allotted (3 hours)? YES NO
   Comments:

6. **Additional Comments:**

Please fax this sheet to (518) 473-0858 or mail it to the New York State Education Department at the above address.